COURSE OUTLINE

(1) GENERAL

SCHOOL	School of Science		
ACADEMIC UNIT	Physics		
LEVEL OF STUDIES	Undergraduate		
COURSE CODE	**10YK016**	**SEMESTER**	**4**
COURSE TITLE	**MATHEMATICAL METHODS IN PHYSICS II**		

INDEPENDENT TEACHING ACTIVITIES *if credits are awarded for separate components of the course, e.g. lectures, laboratory exercises, etc. If the credits are awarded for the whole of the course, give the weekly teaching hours and the total credits*	**WEEKLY TEACHING HOURS**	**CREDITS**
Lectures (theory and exercises)	5	7

COURSE TYPE *general background, special background, specialised general knowledge, skills development*	Special Background
PREREQUISITE COURSES:	No
LANGUAGE OF INSTRUCTION and EXAMINATIONS:	Greek
IS THE COURSE OFFERED TO ERASMUS STUDENTS	No
COURSE WEBSITE (URL)	*https://eclass.uoa.gr/courses/PHYS244/*

(2) LEARNING OUTCOMES

Learning outcomes

The course learning outcomes, specific knowledge, skills and competences of an appropriate level, which the students will acquire with the successful completion of the course are described.

Consult Appendix A

- *Description of the level of learning outcomes for each qualifications cycle, according to the Qualifications Framework of the European Higher Education Area*
- *Descriptors for Levels 6, 7 & 8 of the European Qualifications Framework for Lifelong Learning and Appendix B*
- *Guidelines for writing Learning Outcomes*

The aim of the course is:

1 To familiarize the students with the use of the properties of function vector spaces.

2 To understand the notion and usefulness of expansions into basis functions of a function vector space (e.g., Fourier expansion).

3 To introduce basic types of partial differential equations arising in physics.

4 To solve boundary and initial value problems with the additional use of mathematical methods of the first two aims.

With the completion of the course the student is able to:

Employ the mathematical notions and techniques of the course to solve problems in various branches of physics, as well as of other physical sciences

General Competences

Taking into consideration the general competences that the degree-holder must acquire (as these appear in the Diploma Supplement and appear below), at which of the following does the course aim?

Search for, analysis and synthesis of data and information, with the use of the necessary technology
Adapting to new situations
Decision-making
Working independently
Team work
Working in an international environment
Working in an interdisciplinary environment
Production of new research ideas
Project planning and management
Respect for difference and multiculturalism
Respect for the natural environment
Showing social, professional and ethical responsibility and sensitivity to gender issues
Criticism and self-criticism
Production of free, creative and inductive thinking
……
Others…
…….

The course aims at the following general competences

Working independently
Production of free, creative and inductive thinking
Analytical and synthetic thinking
Critical thinking
Problem solving

(3) SYLLABUS

- Introduction to partial differential equations of mathematical physics (wave, diffusion, and Laplace equations). Classification of partial differential equations. Initial and boundary conditions. Solution methods of solution.

- Inner product spaces. Cauchy-Schwarz inequality, Gram-Schmidt orthonormalization. Complete infinite-dimensional functional spaces. Bessel inequality, Parseval equality, basis of an infinite-dimensional space.

- Fourier series. Linear operators in complete spaces. Self-adjoint operators eigenvalue problems, spectral theorem of self-adjoint operators. Sturm-Liouville systems.

- Study of the wave equation and the diffusion equation on the line, on the half-line, and on finite domains. Fundamental solutions and Green's functions. Reflections and sources

- Boundary value problems for the wave equation and the diffusion equation with homogeneous and inhomogeneous boundary conditions. Problems in Cartesian, cylindrical and spherical coordinates.

- Laplace equation. Basic properties of harmonic functions. Solution of Laplace equation in special geometries in two and three dimensions.

(4) TEACHING and LEARNING METHODS - EVALUATION

<table>
<tr><td>DELIVERY
Face-to-face, Distance learning, etc.</td><td>Face-to-face

Distance learning in exceptional situations</td></tr>
<tr><td>USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY
Use of ICT in teaching, laboratory education, communication with students</td><td>Yes

Electronic communication with the students using ICT (Information and Communications Technology),
eclass platform</td></tr>
<tr><td>TEACHING METHODS
The manner and methods of teaching are described in detail.
Lectures, seminars, laboratory practice, fieldwork, study and analysis of bibliography, tutorials, placements, clinical practice, art workshop, interactive teaching, educational visits, project, essay writing, artistic creativity, etc.

The student's study hours for each learning activity are given as well as the hours of non-directed study according to the principles of the ECTS</td><td>
<table>
<tr><th>Activity</th><th>Semester workload</th></tr>
<tr><td>Lectures</td><td>39</td></tr>
<tr><td>Exercises</td><td>26</td></tr>
<tr><td></td><td>-</td></tr>
<tr><td>Individual Study/ Study and Analysis of bibliography / Preparation</td><td>110</td></tr>
<tr><td></td><td></td></tr>
<tr><td>Course Total</td><td>175</td></tr>
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<tr><td>STUDENT PERFORMANCE EVALUATION
Description of the evaluation procedure

Language of evaluation, methods of evaluation, summative or conclusive, multiple choice questionnaires, short-answer questions, open-ended questions, problem solving, written work, essay/report, oral examination, public presentation, laboratory work, clinical examination of patient, art interpretation, other

Specifically-defined evaluation criteria are given, and if and where they are accessible to students.</td><td>Final written exams in Greek

Oral examination (when appropriate)</td></tr>
</table>

(5) ATTACHED BIBLIOGRAPHY

- Suggested bibliography:

- W. A. Strauss, Μερικές Διαφορικές Εξισώσεις – Μία Εισαγωγή, Εκδ. 2 (Πανεπιστημιακές Εκδόσεις ΕΜΠ, 2017).
- Σ. Τραχανάς, Μερικές Διαφορικές Εξισώσεις – Σειρές Fourier και Προβλήματα Συνοριακών Τιμών (ΙΤΕ-Πανεπιστημιακές Εκδόσεις Κρήτης, 2009).
- Ι. Δ. Βέργαδος, Γ. Κ. Λεοντάρης, Μαθηματικές Μέθοδοι Φυσικής - Τόμος Ι (Εκδόσεις Συμμετρία, 2020).
- Σημειώσεις των διδασκόντων στην η-τάξη.